

WHAT IS CLAIMED IS:

1. A method for polishing a substrate comprising a metal in an oxidized form, the method comprising the steps of:

- (a) providing a substrate comprising a metal in an oxidized form,
- (b) contacting a portion of the substrate with a chemical-mechanical polishing system comprising:
 - (i) a polishing component selected from the group consisting of an abrasive, a polishing pad, and a combination thereof,
 - (ii) a reducing agent selected from the group consisting of 3-hydroxy-4-pyrone, α -hydroxy- γ -butyrolactones, borane, borohydrides, dialkylamine boranes, formaldehyde, formic acid, hydrogen, hydroquinones, hydroxylamine, hypophosphorous acid, trihydroxybenzenes, solvated electrons, sulfurous acid, salts thereof, and mixtures thereof, and
 - (iii) a liquid carrier, and
- (c) abrading at least a portion of the metal in an oxidized form to polish the substrate.

2. The method of claim 1, wherein the oxidized form is selected from the group consisting of oxides, nitrides, borides, sulfides, and mixtures thereof.

3. The method of claim 2, wherein the oxidized form is an oxide, and the metal in an oxidized form has a molecular formula M_xO_y in which M represents the metal and x and y represent integers, where y is greater than or equal to x.

4. The method of claim 2, wherein the metal is tantalum.

5. The method of claim 2, wherein the metal is a noble metal selected from the group consisting of platinum, iridium, ruthenium, rhodium, palladium, silver, osmium, gold, and combinations thereof.

6. The method of claim 5, wherein the metal in an oxidized form is iridium oxide.

7. The method of claim 6, wherein the reducing agent is selected from the group consisting of dimethylamine borane, formic acid, hydroquinone, hydroquinone

sulfonic acid, hydroxylamine, hypophosphorous acid, trihydroxybenzenes, salts thereof, and mixtures thereof.

8. The method of claim 7, wherein the chemical-mechanical polishing system comprises an abrasive suspended in the liquid carrier, and the abrasive comprises a metal oxide selected from the group consisting of alumina, silica, ceria, zirconia, titania, germania, co-formed products thereof, and combinations thereof.

9. The method of claim 8, wherein the abrasive comprises silica, fumed alumina, or a combination thereof.

10. The method of claim 8, wherein the abrasive comprises α -alumina.

11. The method of claim 1, wherein the metal is tantalum.

12. The method of claim 1, wherein the metal is a noble metal selected from the group consisting of platinum, iridium, ruthenium, rhodium, palladium, silver, osmium, gold, and combinations thereof.

13. The method of claim 12, wherein the chemical-mechanical polishing system comprises an abrasive suspended in the liquid carrier and the abrasive comprises a metal oxide selected from the group consisting of alumina, silica, ceria, zirconia, titania, germania, co-formed products thereof, and combinations thereof.

14. The method of claim 13, wherein the abrasive comprises silica, fumed alumina, or a combination thereof.

15. The method of claim 13, wherein the abrasive comprises α -alumina.

16. The method of claim 1, wherein the chemical-mechanical polishing system comprises an abrasive suspended in the liquid carrier.

17. The method of claim 16, wherein the abrasive comprises a metal oxide selected from the group consisting of alumina, silica, ceria, zirconia, titania, germania, co-formed products thereof, and combinations thereof.

18. The method of claim 17, wherein the abrasive comprises silica, fumed alumina, or a combination thereof.

19. The method of claim 17, wherein the abrasive comprises α -alumina.

20. The method of claim 1, wherein the reducing agent is selected from the group consisting of dimethylamine borane, formic acid, hydroquinone, hydroquinone sulfonic acid, hydroxylamine, hypophosphorous acid, trihydroxybenzenes, salts thereof, and mixtures thereof.

21. The method of claim 1, wherein the chemical-mechanical polishing system comprises about 0.1 to about 5 wt.% reducing agent based on the weight of the liquid carrier and any components dissolved or suspended therein.

22. The method of claim 1, wherein the chemical-mechanical polishing system comprises an abrasive, and the abrasive is fixed to a polishing pad.

23. The method of claim 1, wherein the liquid carrier comprises water.

24. The method of claim 1, wherein the chemical-mechanical polishing system further comprises a complexing agent.

25. The method of claim 1, wherein the chemical-mechanical polishing system further comprises a pH buffering agent.

26. The method of claim 1, wherein the chemical-mechanical polishing system further comprises a surfactant.

27. A method for polishing a substrate comprising a metal in an oxidized form, the method comprising the steps of:

(a) providing a substrate comprising a metal in an oxidized form,
(b) contacting a portion of the substrate with a chemical-mechanical polishing system comprising:

- (i) a polishing component selected from the group consisting of an abrasive, a polishing pad, and a combination thereof,
- (ii) about 0.1 to about 1 wt.% of a reducing agent based on the weight of the liquid carrier and any components dissolved or suspended

therein, the reducing agent being selected from the group consisting of 3-hydroxy-4-pyrones, α -hydroxy- γ -butyrolactones, ascorbic acid, borane, borohydrides, dialkylamine boranes, formaldehyde, formic acid, hydrogen, hydroquinones, hydroxylamine, hypophosphorous acid, trihydroxybenzenes, solvated electrons, sulfurous acid, salts thereof, and mixtures thereof, and

(iii) a liquid carrier, and

(c) abrading at least a portion of the metal in an oxidized form to polish the substrate.

28. The method of claim 27, wherein the chemical-mechanical polishing system comprises about 0.1 to about 0.5 wt.% reducing agent based on the weight of the liquid carrier and any components dissolved or suspended therein.

29. A method for polishing a substrate comprising a metal in an oxidized form, the method comprising the steps of:

(a) providing a substrate comprising a metal in an oxidized form,
(b) contacting a portion of the substrate with a chemical-mechanical polishing system comprising:

- (i) a polishing component selected from the group consisting of an abrasive, a polishing pad, and a combination thereof,
- (ii) a reducing agent selected from the group consisting of 3-hydroxy-4-pyrones, α -hydroxy- γ -butyrolactones, borane, borohydrides, dialkylamine boranes, formaldehyde, formic acid, hydrogen, hydroquinones, hydroxylamine, hypophosphorous acid, a metal or metal ions in an oxidation state having a standard redox potential that is less than the standard redox potential of the metal in an oxidized form, trihydroxybenzenes, solvated electrons, sulfurous acid, salts thereof, and mixtures thereof, and
- (iii) a liquid carrier,
wherein the polishing system does not comprise an oxidizing agent, and

(c) abrading at least a portion of the metal in an oxidized form to polish the substrate.

30. A method for polishing a substrate comprising a metal in an oxidized form, the method comprising the steps of:

(a) providing a substrate comprising a metal in an oxidized form,

(b) contacting a portion of the substrate with a chemical-mechanical polishing system comprising:

(i) a polishing component selected from the group consisting of an abrasive, a polishing pad, and a combination thereof, wherein the polishing component does not comprise a mixture of α -alumina and fumed alumina,

(ii) a reducing agent selected from the group consisting of 3-hydroxy-4-pyrones, α -hydroxy- γ -butyrolactones, borane, borohydrides, dialkylamine boranes, formaldehyde, formic acid, hydrogen, hydroquinones, hydroxylamine, hypophosphorous acid, phosphorous acid, a metal or metal ions in an oxidation state having a standard redox potential that is less than the standard redox potential of the metal in an oxidized form, trihydroxybenzenes, solvated electrons, sulfurous acid, salts thereof, and mixtures thereof, and

(iii) a liquid carrier, and

(c) abrading at least a portion of the metal in an oxidized form to polish the substrate.